



MU-SPIN/MURED Conference

Integration of Multidisciplinary Engineering Analysis Software for Teaching & Research

Chivey Wu & Maj Mirmirani

Department of Mechanical Engineering
California State University, Los Angeles

Sept 14, 2000



Goals

- Interface for Multidisciplinary CAD/FEA/CFD/Control Software
- Courses in Multidisciplinary CAD/CAE
- Application to Flight Vehicle Design, Analysis and Control Simulation

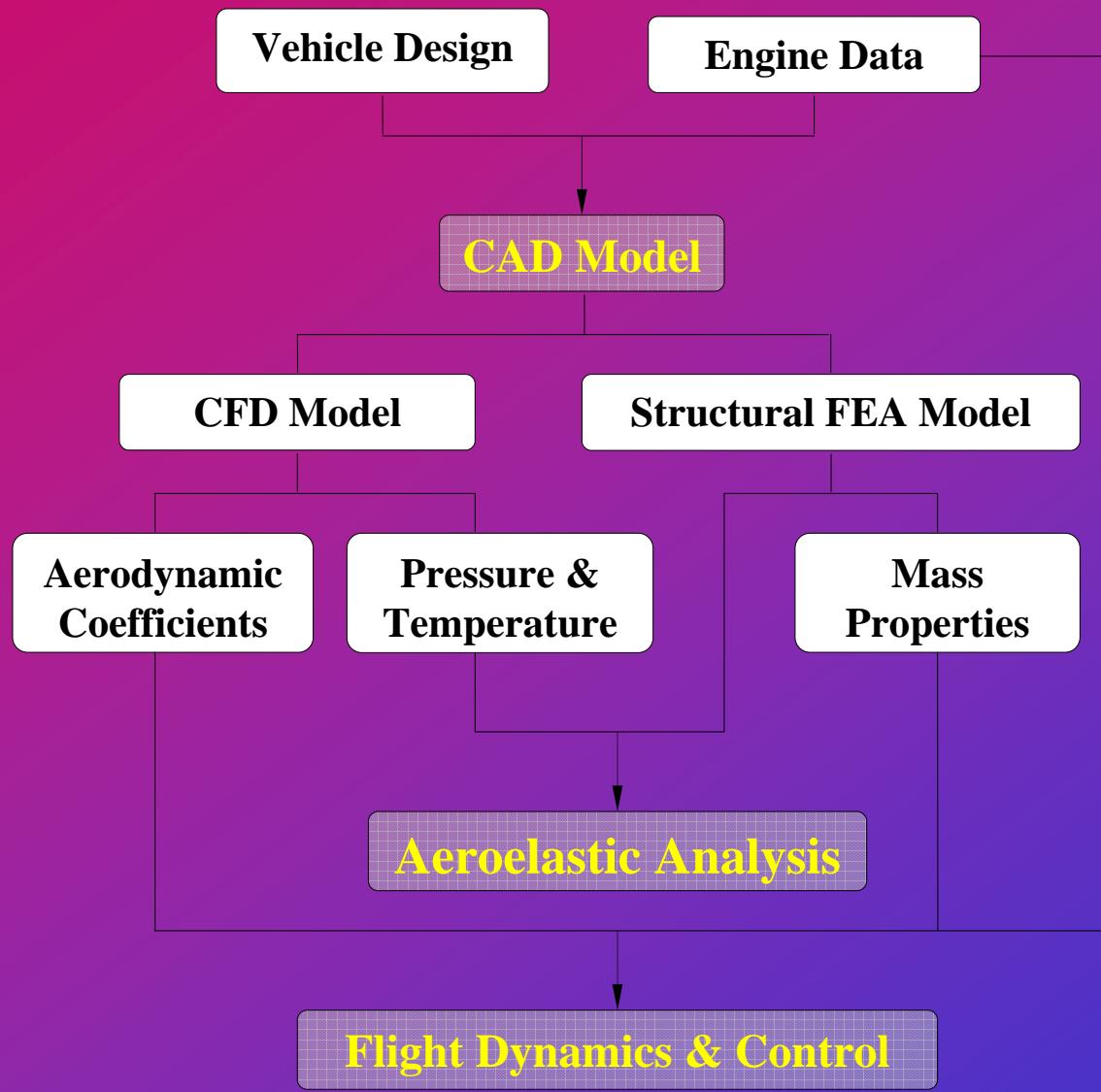


Software

- CAD/FEM : SDRC *IDEAS*
- FEA/CFD : NASA *STARS*
CSULA *I-Newton*
- Flight Control : CSULA *I-CONT*
- Interface : CSULA *I-STARS*
GUI, Data Translators



I-STARS Multidisciplinary CAE System





I-STARS Graphical User Interface

I-STARS

File Edit View Application Stars Convert Window Help

DIR

STARS CFDASE MENU

CFDASE

ISTARS(CFD) To translate I-DEAS CFD model to STARS model (*.prg) -> (*.fro, *.bco, *.grl)

SETBND1 To set the boundary conditions for STEADYDP

SETBND-I To set the bound

CFD CONS To specify CFD

STEADYDP To perform the

STEADY CFD To run steady i

UNSTEADY To perform the

INTERFACE To generate in

REMESH To adaptively r

XPLT To plot surface

POSTPLOT To visualize CF

CFD UTIL To compute co

CFD Steady Analysis

Steady flow computation

Project Name Type

Sp. Ht. ratio (Gamma) 1.4
 Single case computarion

Mach Number (Mach) 0.6
Angle of attack (Alpha) 0
Angle of sideslip (Beta) 0

Multi-alpha computation

Alpha 0 to 9 step 1
 Multi-Mach computaion

Mach 0.5 to 1 step 0.1

Specify CFD control parameters and free stream condition

Solution time step 1 Number of substeps 1000
CFL number 2.8 Write result every 100

Restart
 Yes
 No

Debugging
 Yes
 No

Solution Method
 Low-order
 High-order

Bulk viscosity
 Compute
 Do not compute

Transient analysis
 Include
 Do not include

Advance Control

tolerance	0.0001	diss1	1.0	nite0	1	disx	6.0	cbt(1)	1.0
relax	1.0	diss2	1.0	nite1	1	xc1	-1.2	cbt(2)	0.5
nstage	5	nsmth	0.0	nite2	1	xc2	-0.2	cbt(3)	0.0
meshc	1	smofc	0.25	nlimit	1	xc3	0.014	cbt(4)	0.0
meshf	1	epslm	0.2	lg	1	xc4	0.0714	cbt(5)	0.0

Aerodynamic forces

Surface Range : 1 To 1
Coordinates to find Moments
X 0 Y 0 Z 0

Altitude (m) 0 Update

S.Speed 1 Density 1

RUN CANCEL

NASTRAN MSC

NASA STARS

STARS CFD

CFD NEON

STARS SOLID

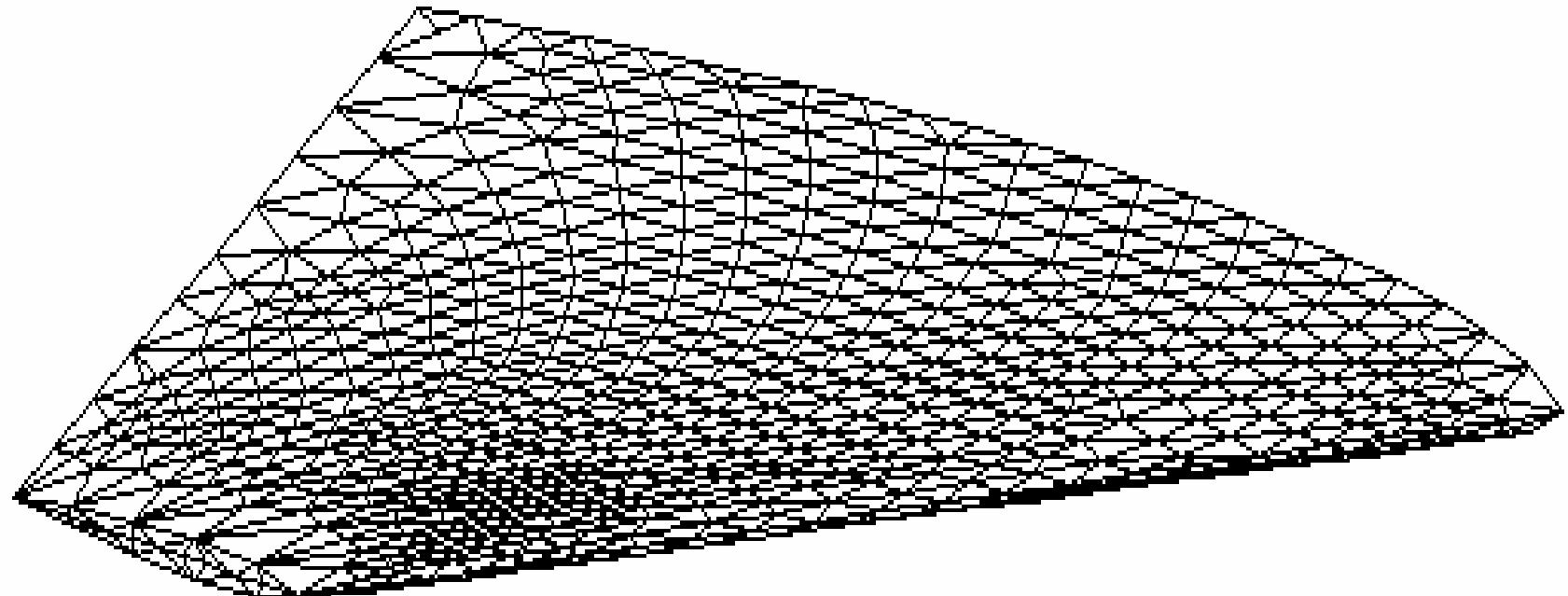
Ready

Ln 1, Col 1

NUM

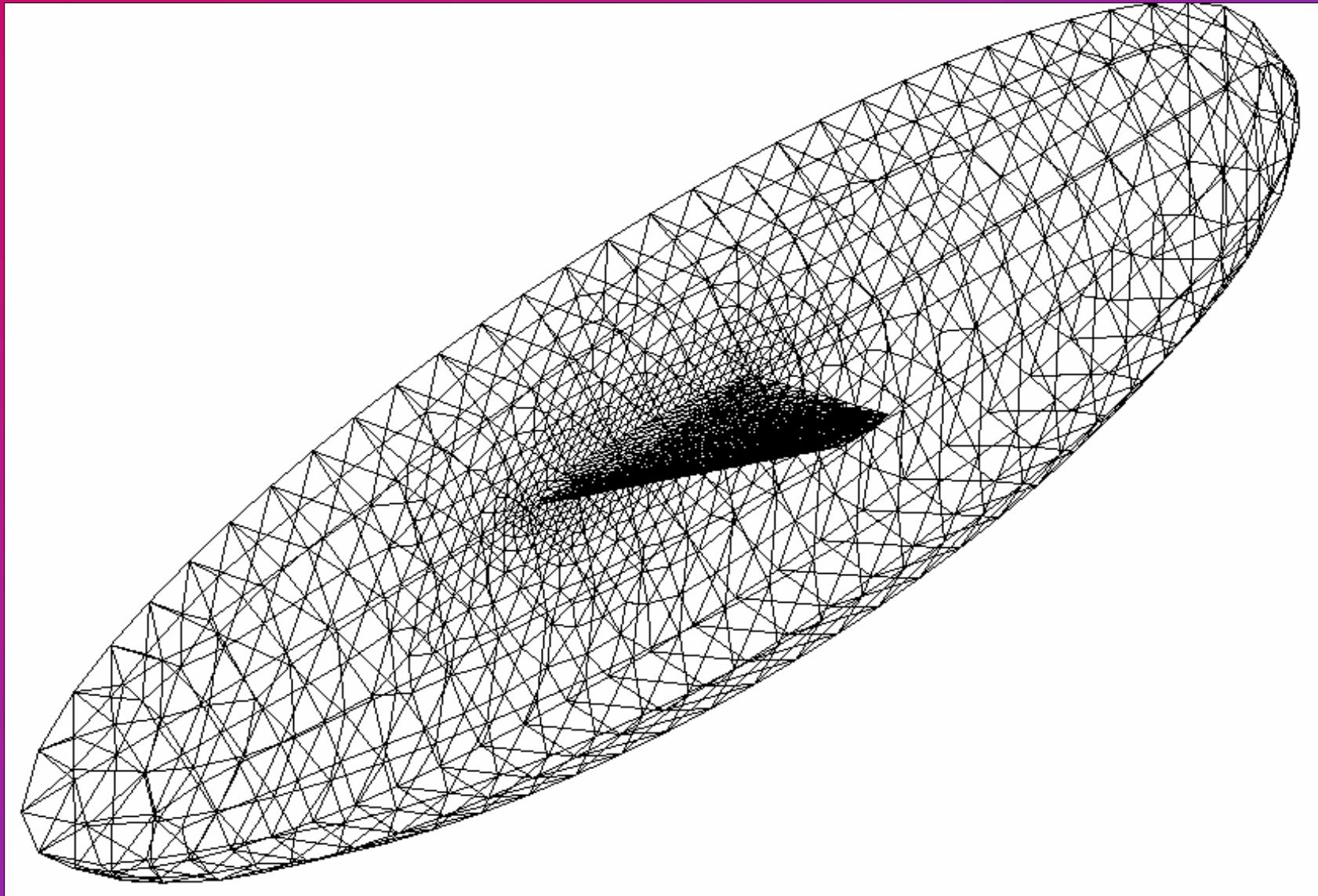


IDEAS FEM of a Wing



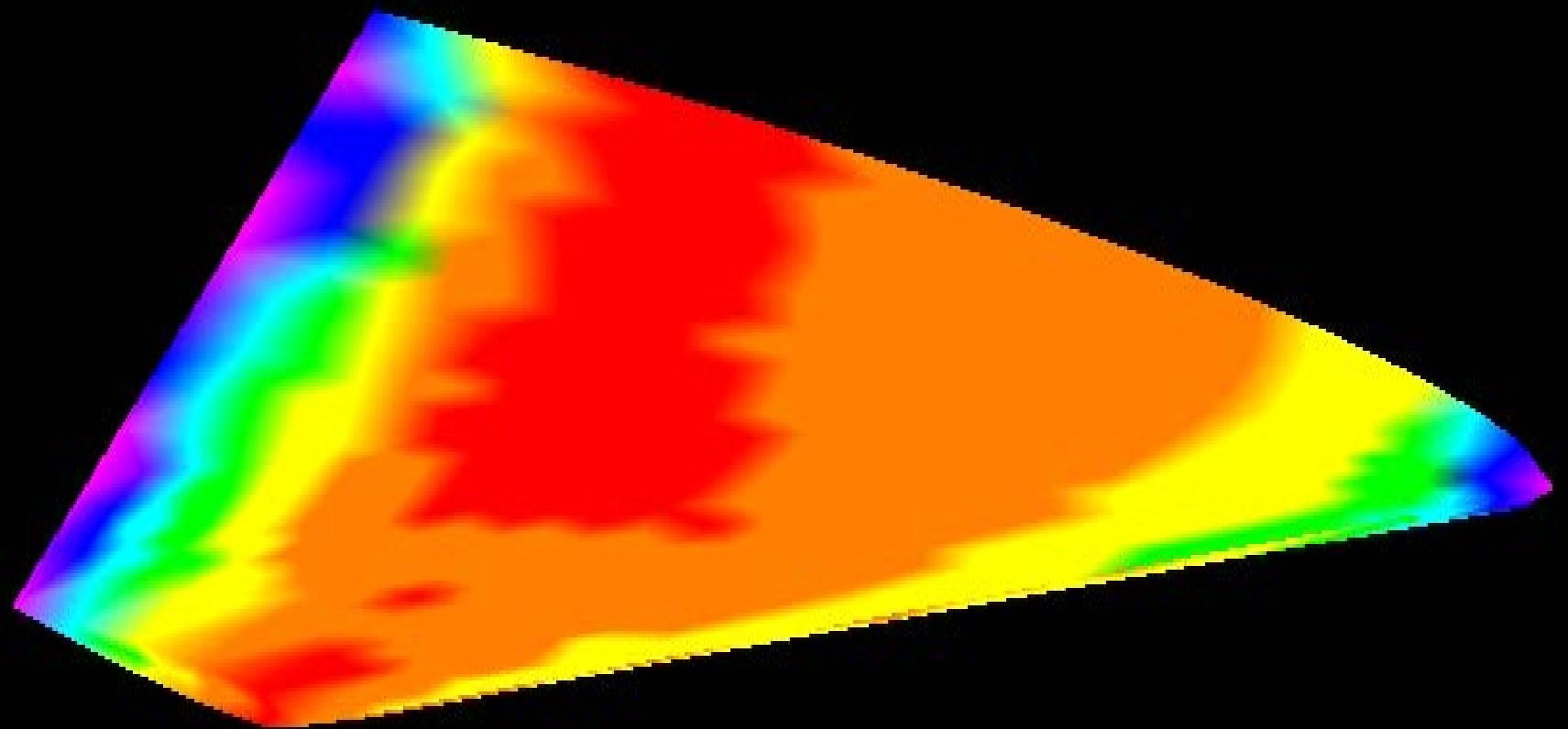


... and the corresponding CFD mesh



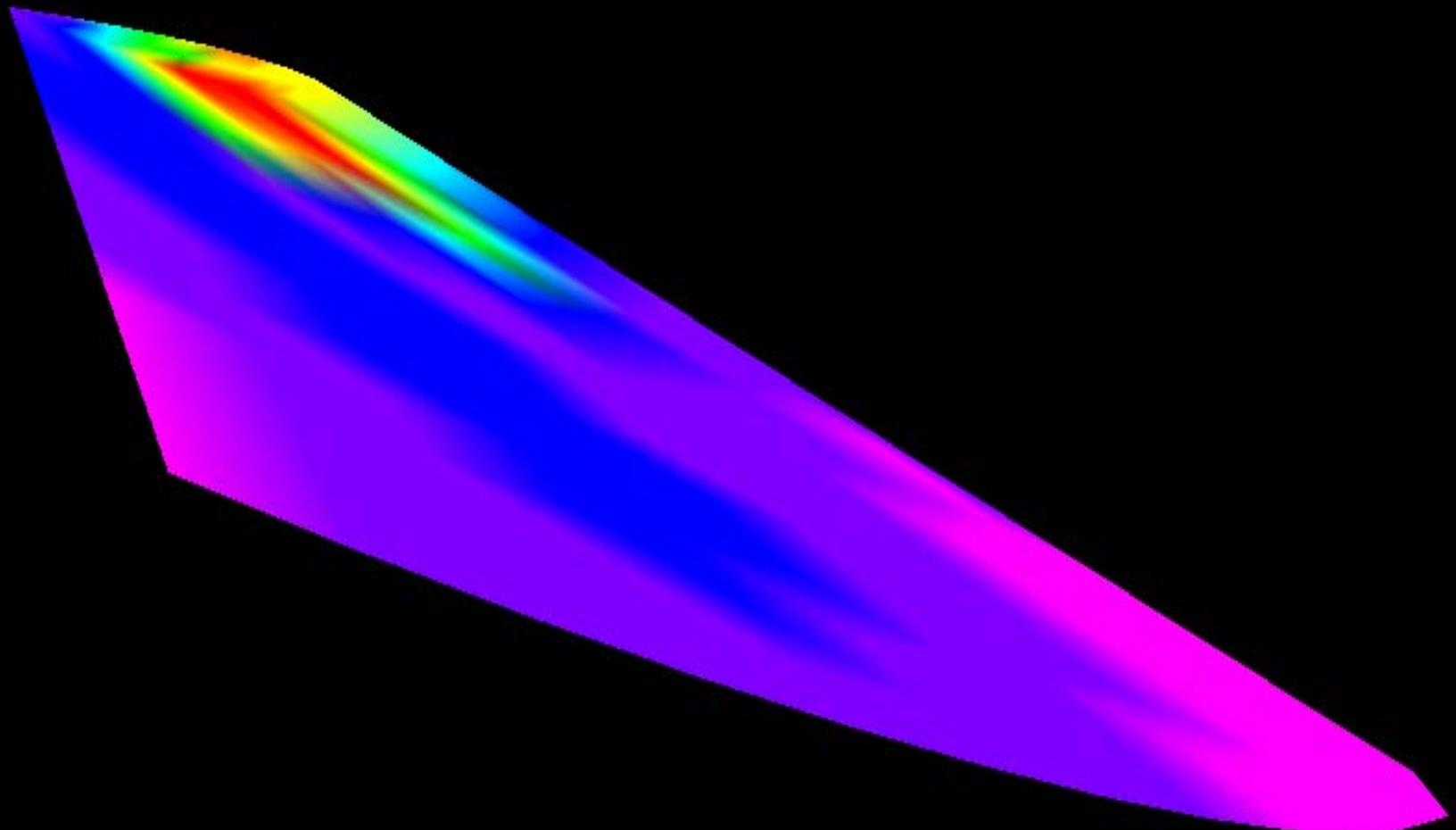


CFD Simulation: Mach Contours



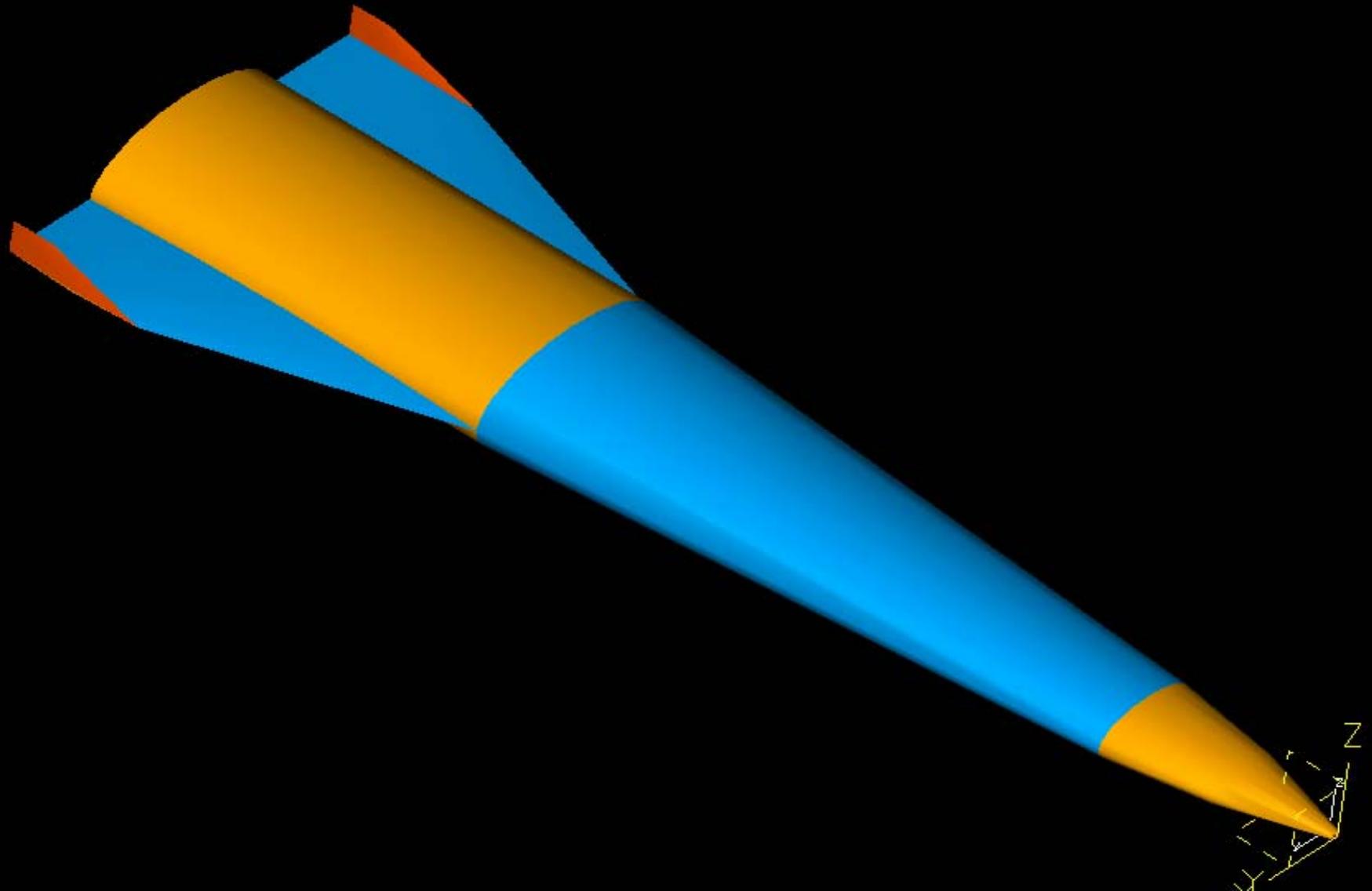


Aeroelastic analysis



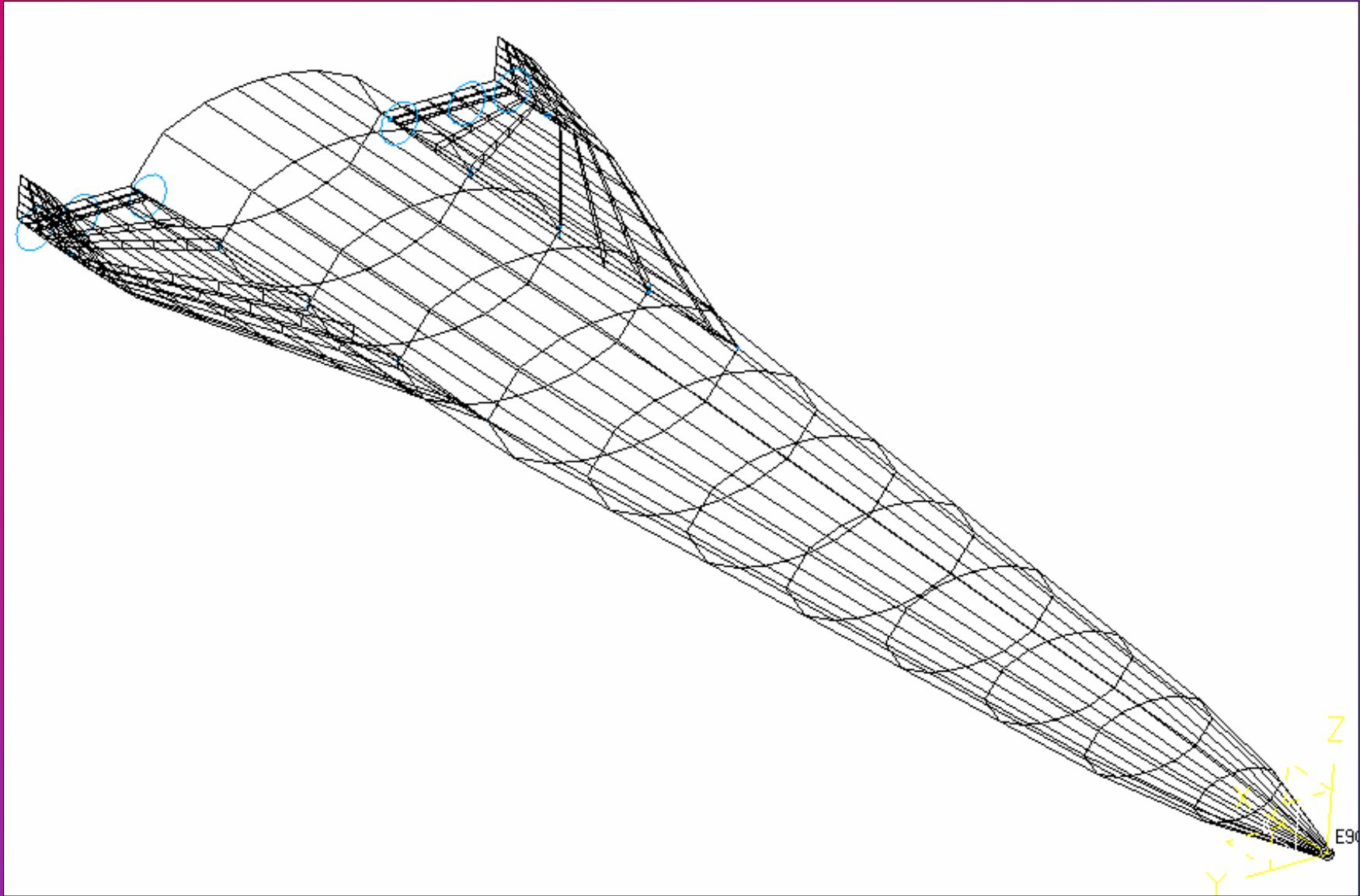


Generic Hypersonic Vehicle - CAD Model



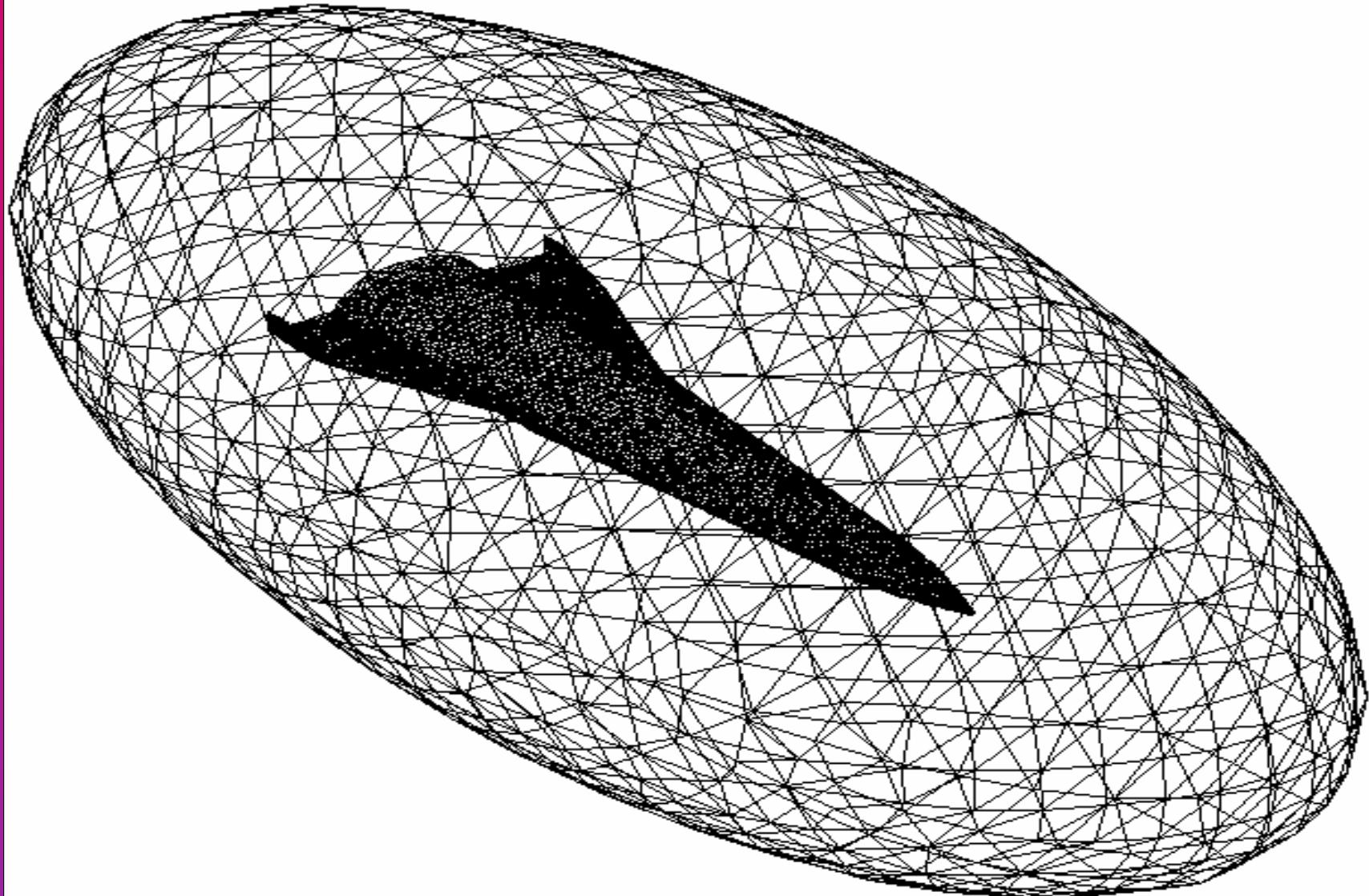


GHV Structure - IDEAS FEM



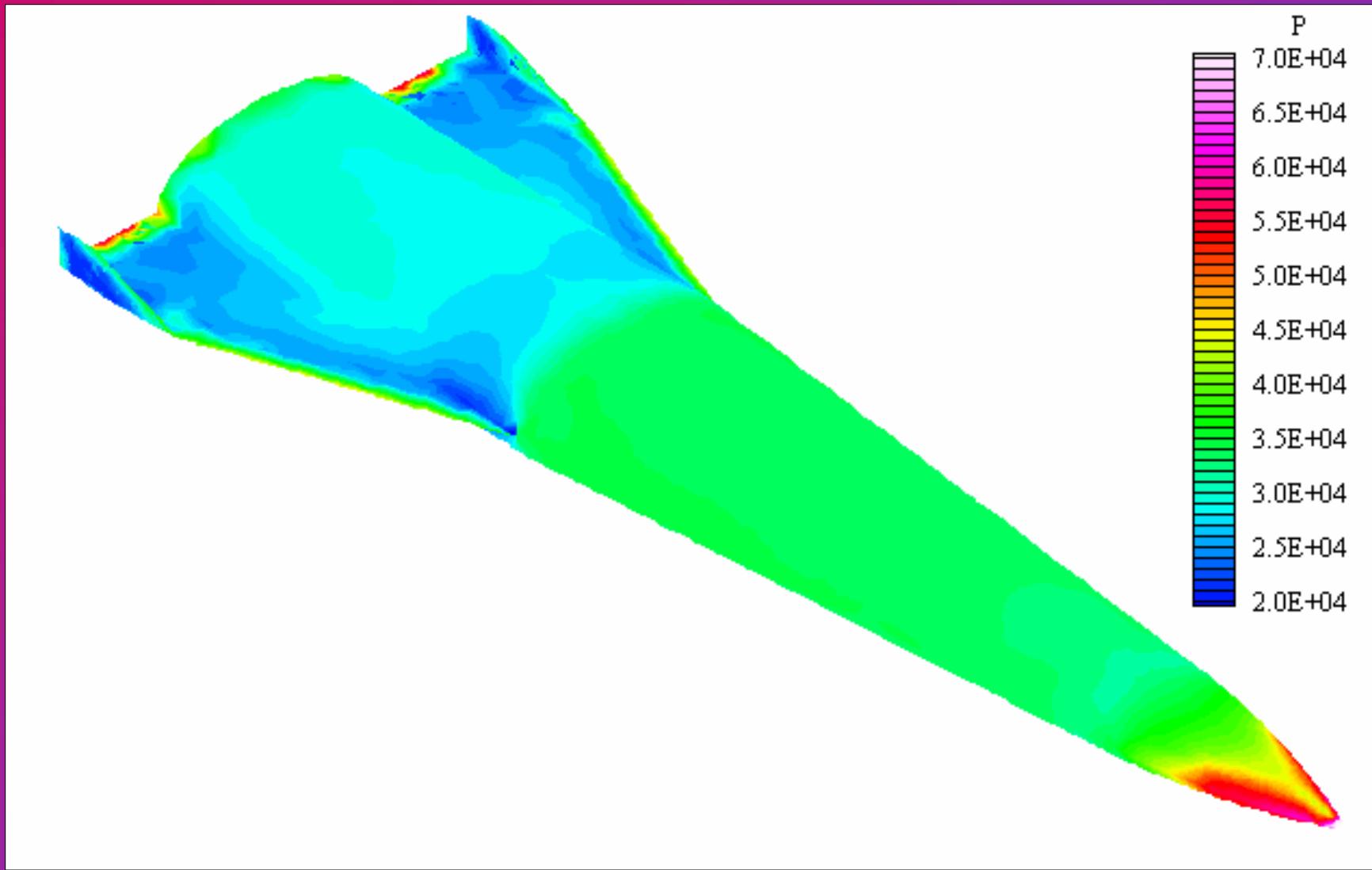


GHV - CFD Mesh



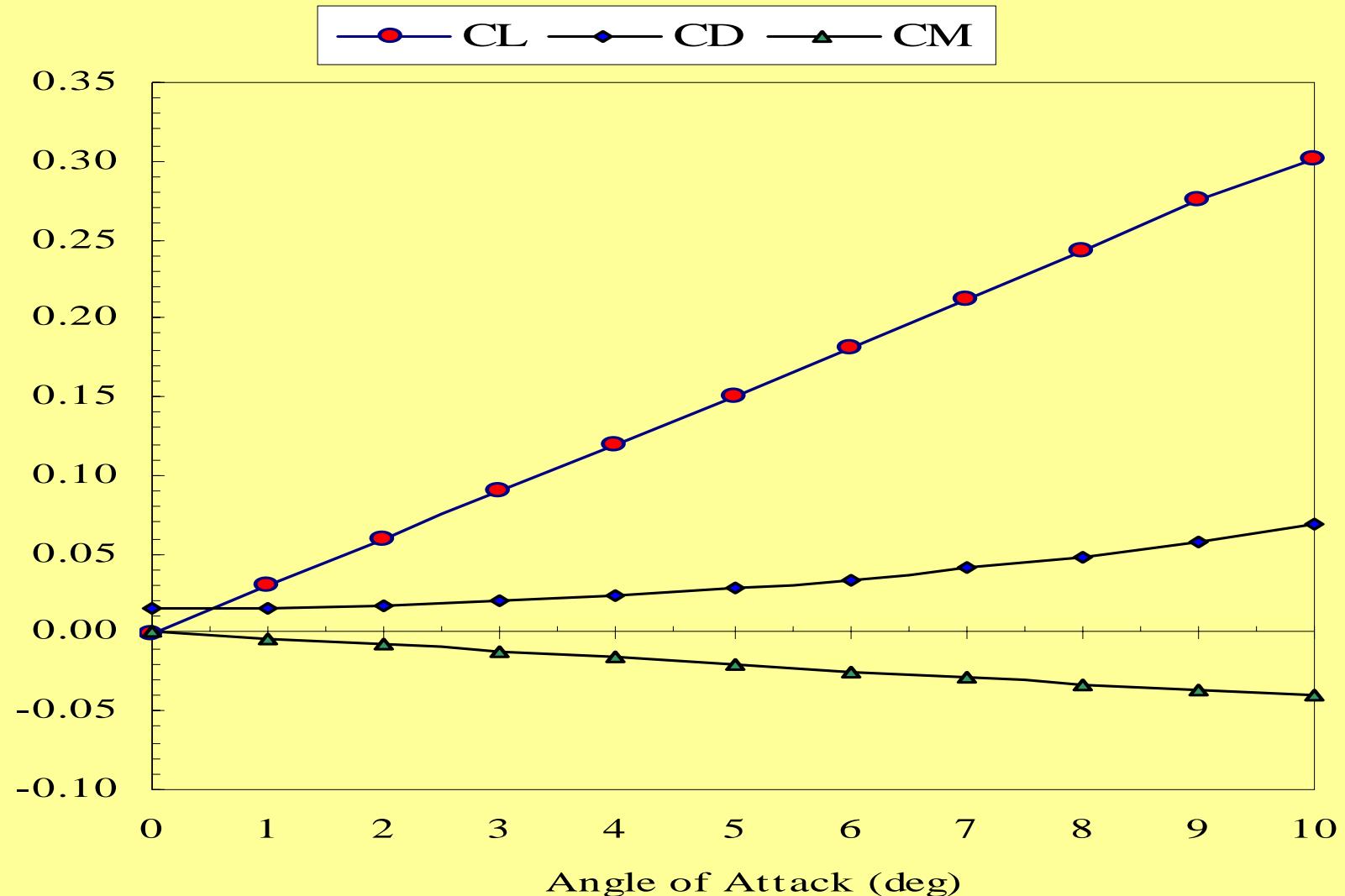


CFD Simulation - Surface Pressure



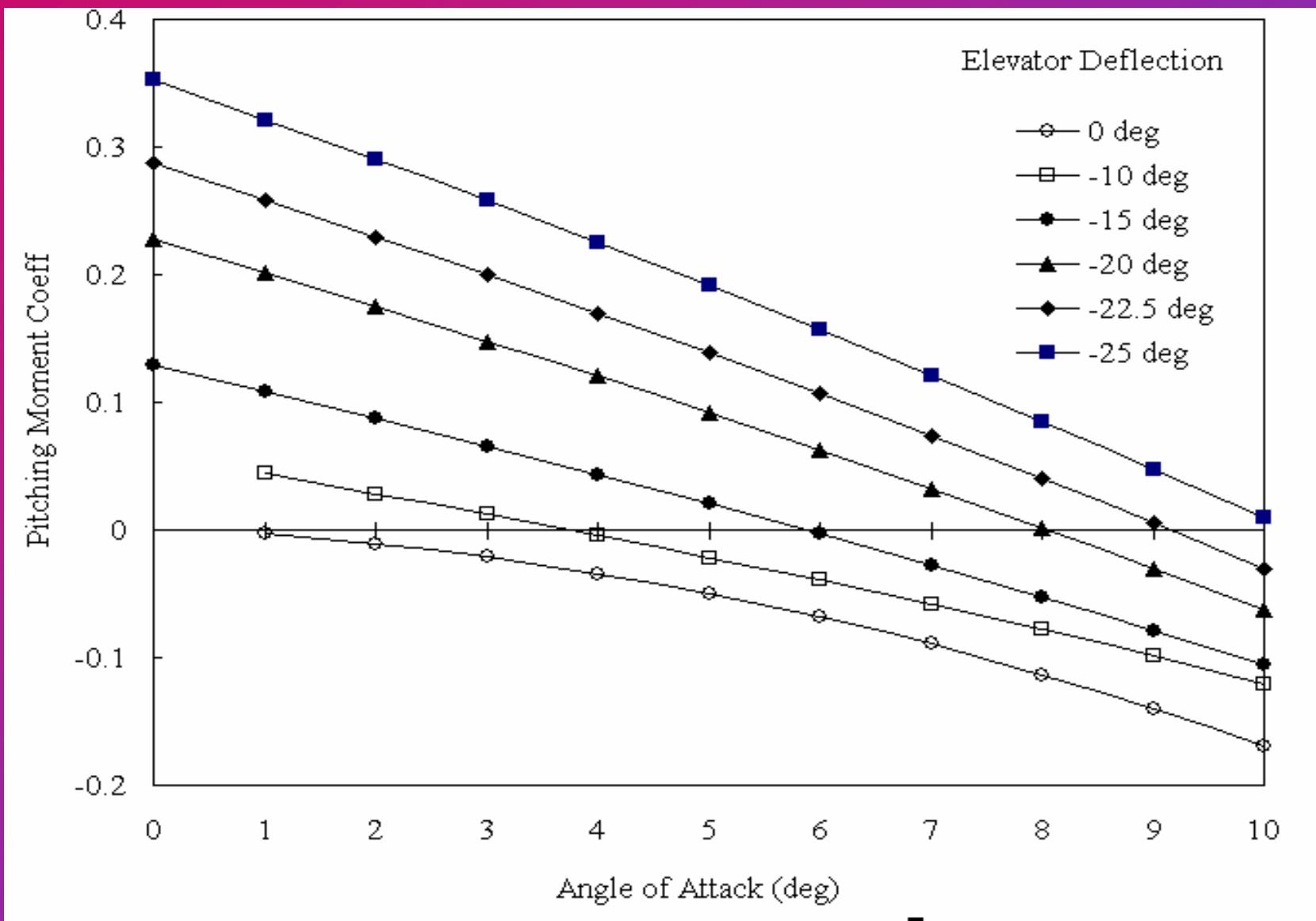


Aerodynamic Coefficients



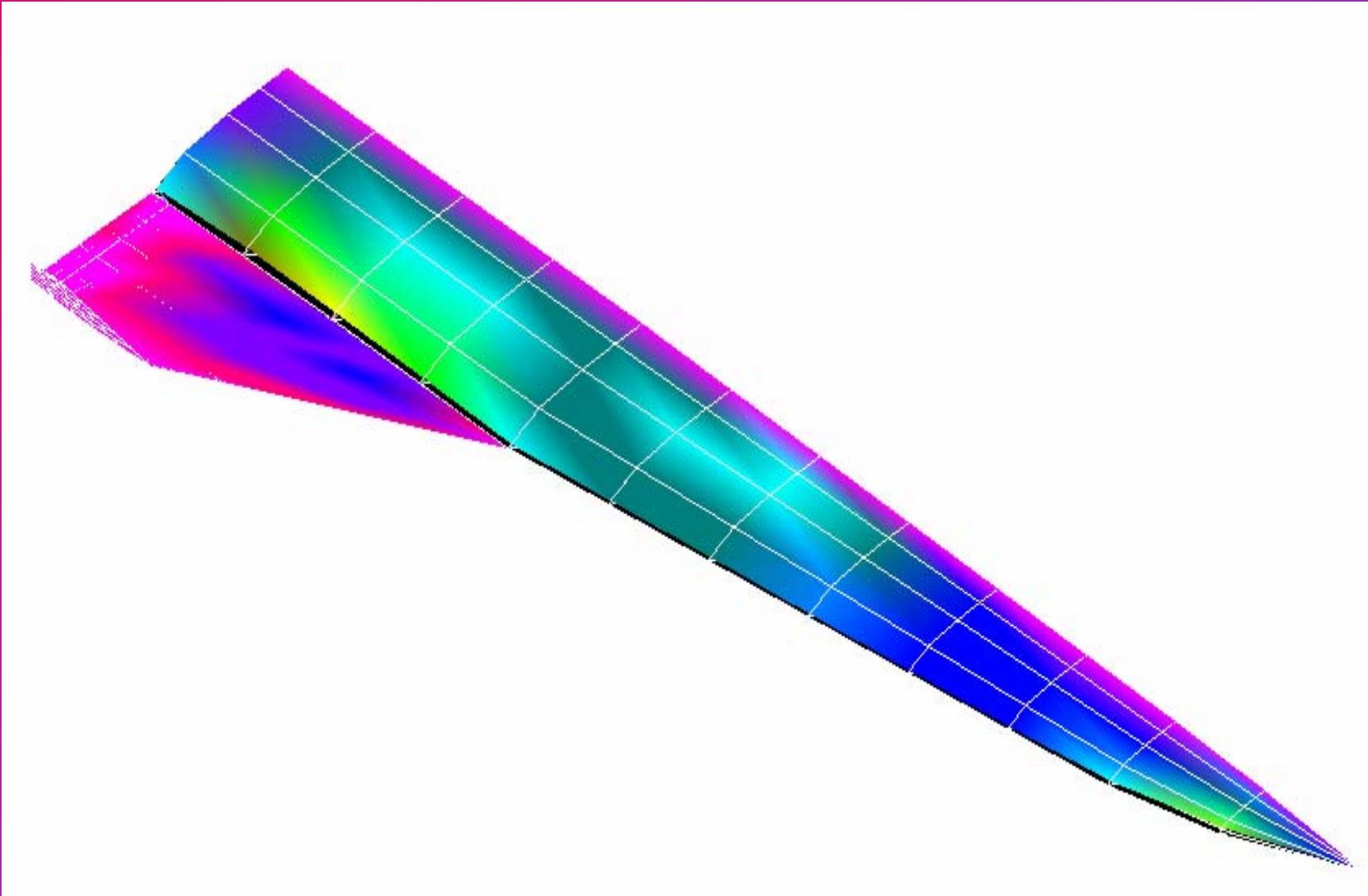


Effect of Elevator



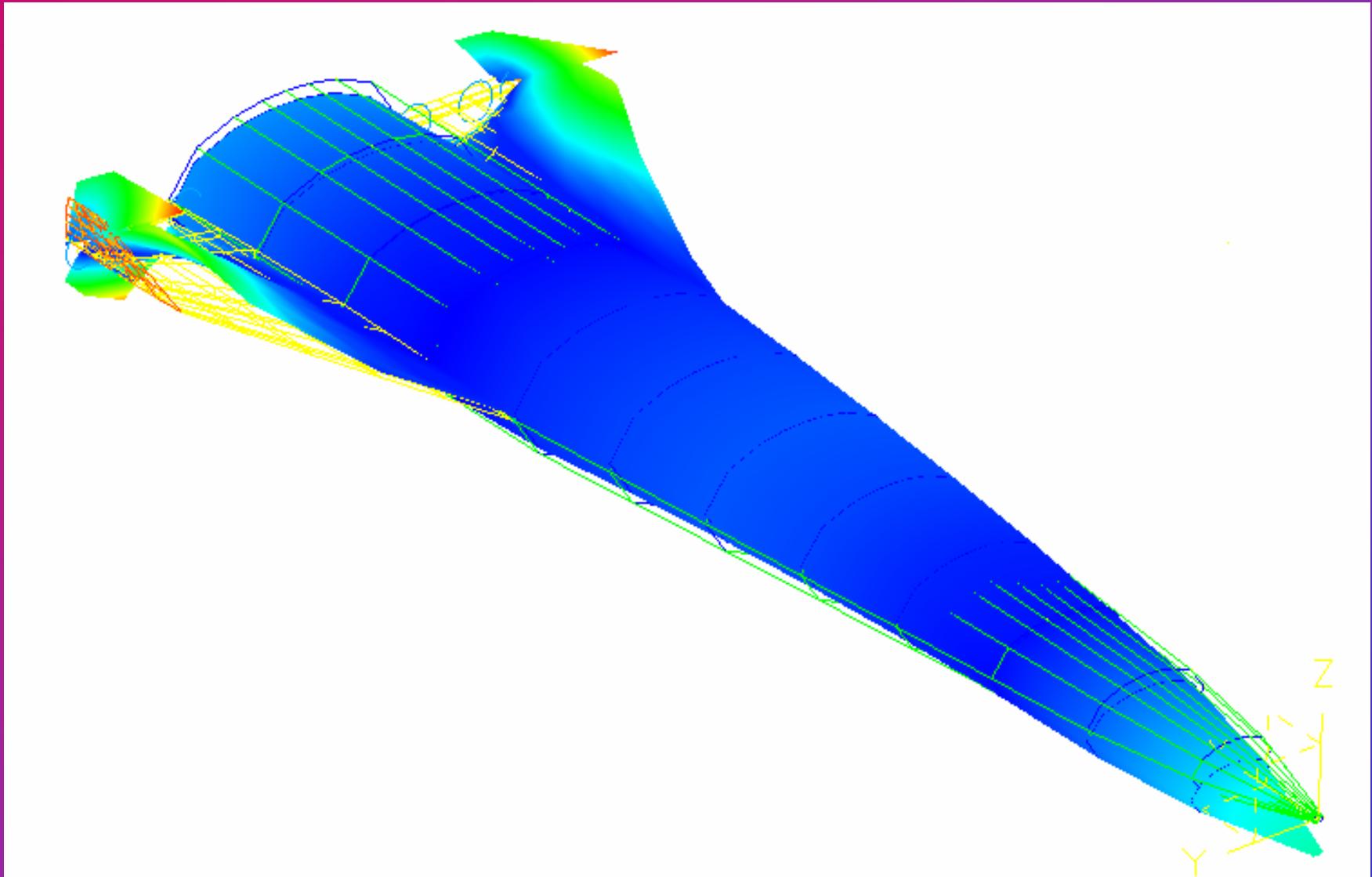


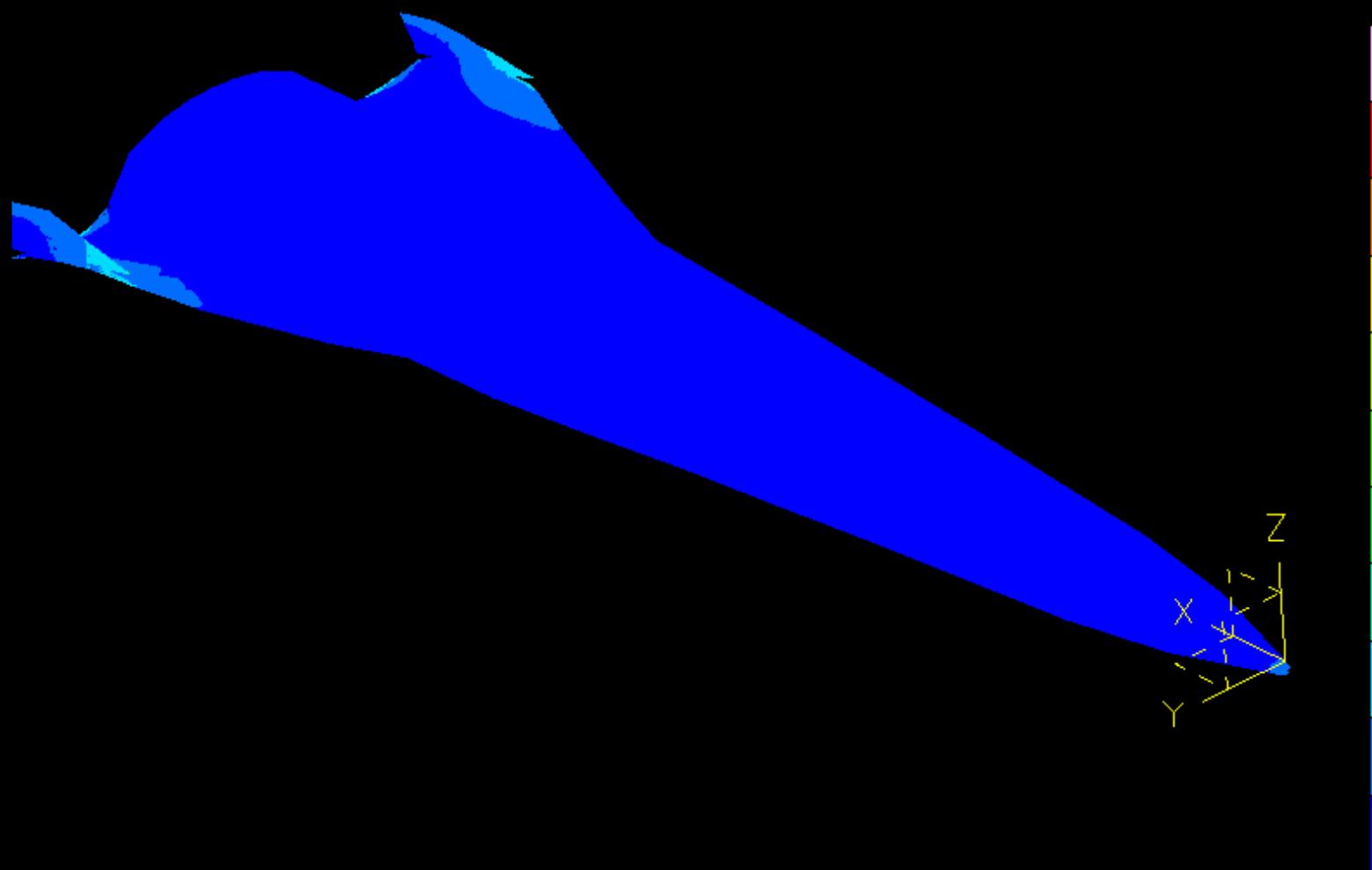
Static Stress Analysis





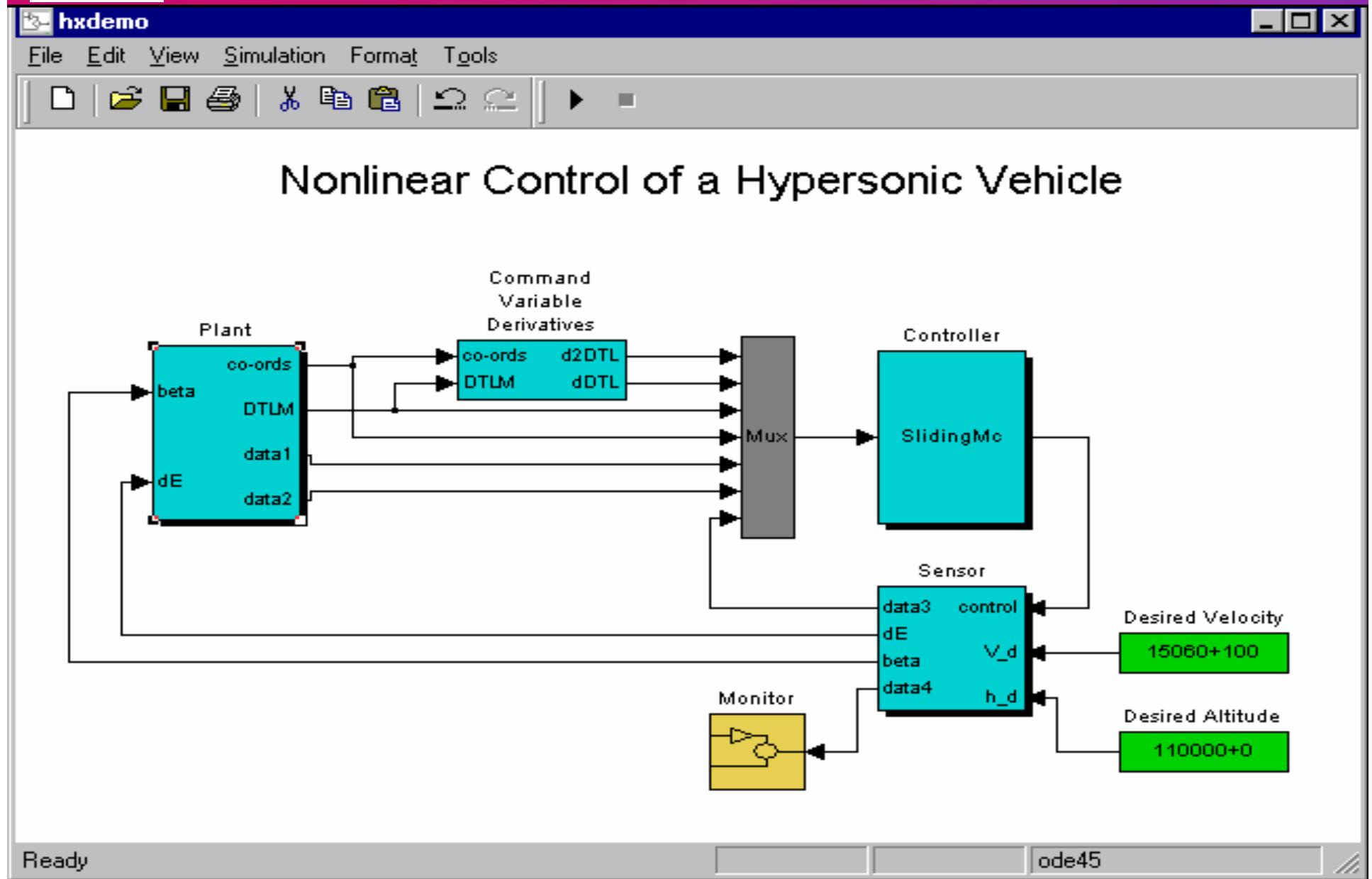
Vibration Analysis





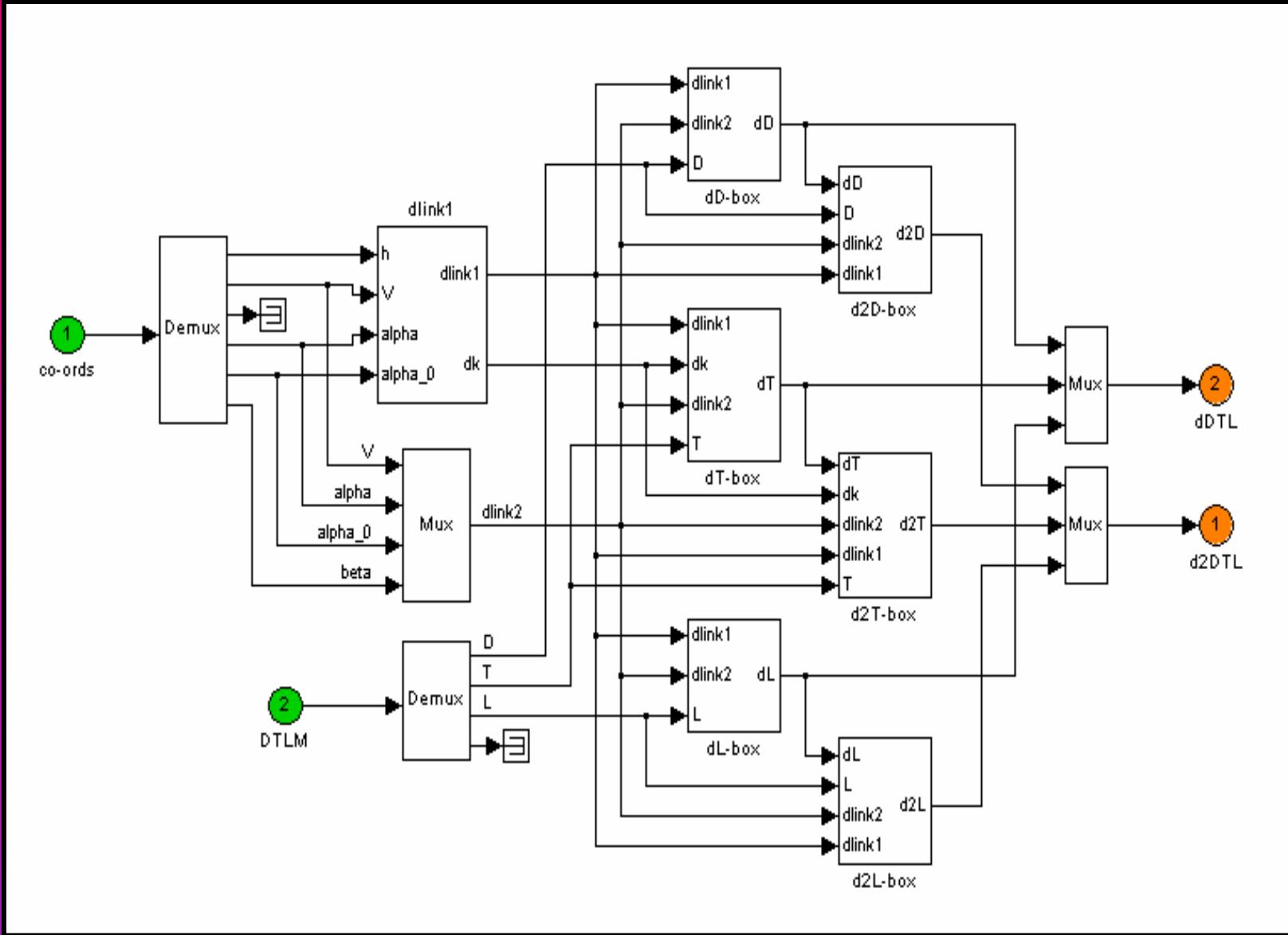


I-CONT Flight Control Simulator



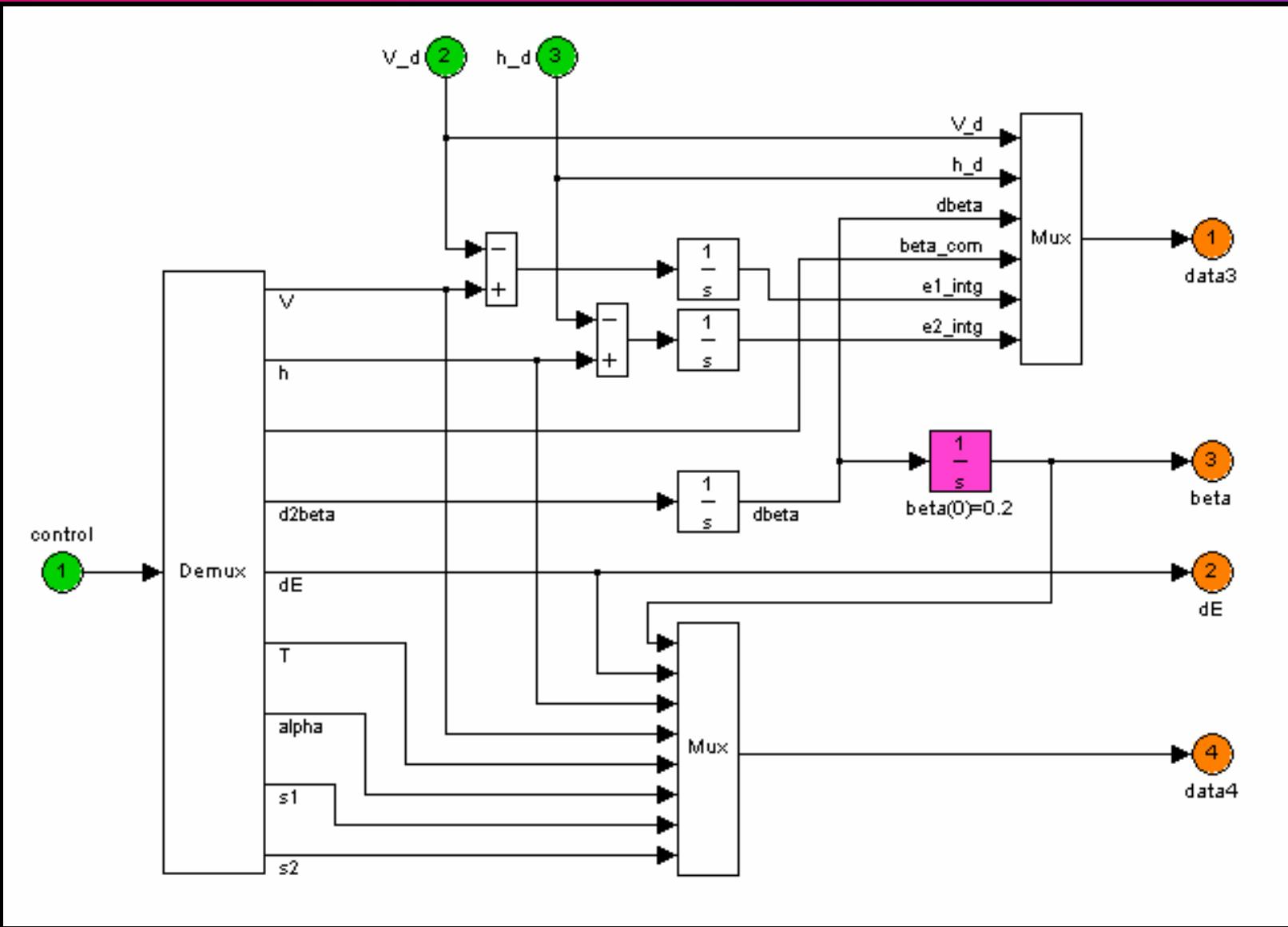


I-CONT Controller



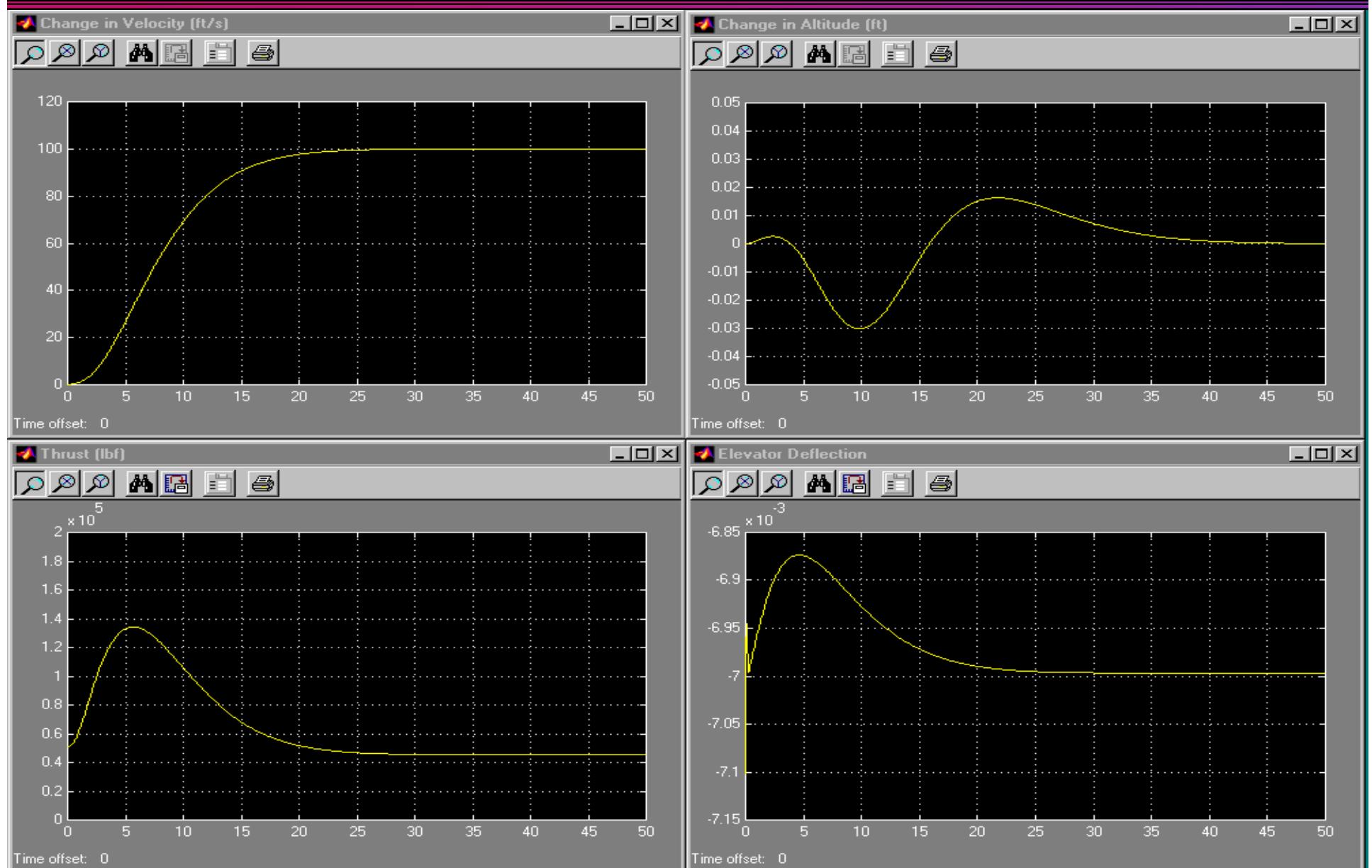


I-CONT Sensor





Response to a Step Velocity Command





Courses

- ME318 Computer-Aided Mech Engr
- ME403 Aerodynamics
- ME409 Applied Multidisciplinary FEA
- ME454 Flight Dynamics Control
- ME508 Computational Fluid Dynamics



NASA-Sponsored Projects

- Integrated Aircraft Design & Analysis

Dr. Chivey Wu

- Control of Hypersonic Vehicles

Dr. Maj Mirmirani

- Applications of Inflatable Structures

Dr. Lih-Min Hsia